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SUBJECT: Discharge Limits/Rates and Treatment Approaches for Chlorine and Bromine from Pools and Spas

This memorandum responds to GLEC's request that ERG provide technical assistance on discharge limits/rates and treatment approaches for chlorine and bromine from vessel pools and spas (Item 4 of EPA's technical direction dated September 22).

Pool and Spa Operations - Vessel Sanitation Program

The Centers for Disease Control and Prevention (CDC) established the Vessel Sanitation Program (VSP) in the 1970's in cooperation with the cruise ship industry to ensure the development and implementation of comprehensive sanitation programs to minimize the risk of gastrointestinal diseases. Every vessel that has a foreign itinerary and carries 13 or more passengers is subject to twice-yearly inspections and, when necessary, reinspection.¹

Chapter 6 of the 2005 VSP Operations Manual describes operating practices for swimming pools and whirlpool spas. Most of the requirements address circulation, filtration, halogenation, and water quality to protect public health during use. Additionally, the manual also includes the following requirements related to wastewater discharge:

- Flow-through sea water swimming pools are operated only when underway at sea beyond 12 miles from shore. Such pools are drained before reaching port and remain empty while in port.
- Recirculating swimming pools are backwashed as recommended by the manufacturer.
- Granular filters on whirlpool spas are backwashed at least daily until the sight glass indicates a clear flow.
- Whirlpool spa water is changed daily.
- In the event of a fecal accident, drain pool/spa greater than 12 nautical miles (nm) from land.

The manual does not include any discharge limits/rates for pool and spa water.

¹ <http://www.cdc.gov/nceh/vsp/operationsmanual/OPSMannual2005.pdf>

Cruise Lines International Association (CLIA) waste management guidelines specify discharge of pool water greater than 4 nm from land. Hyper-chlorinated spa water is dechlorinated and then discharged greater than 4 nm from land.²

Responses to EPA's survey of 29 cruise ships operating in Alaska in 2004 indicated that most ships discharge pool and spa wastewater overboard. Many cruise lines specified that such discharges occur greater than 12 nm from land. However, several indicated that pool and particularly spa wastewater is routed to their graywater system.

Discharge Limits/Rates for Chlorine and Bromine from Pools and Spas

Federal Limits

There are no federal discharge limitations regarding the discharge of chlorine and bromine from pools and spas, much less from vessel pools and spas. The only exceptions are for those cruise ships operating in Alaska waters that route pool and/or spa water to their graywater systems. For these ships, their combined discharge must achieve the Title XIV discharge limitation of 10 µg/L for total residual chlorine.

EPA has established National Recommended Water Quality Criteria (NRWQC) for chlorine as listed in Table 1. EPA has not established NRWQC for bromine.

Table 1. NRWQC for Chlorine

Analyte	Freshwater		Saltwater ¹	
	NRWQC Criteria Maximum Concentration (CMC)	NRWQC Criterion Continuous Concentration (CCC)	NRWQC Criteria Maximum Concentration (CMC)	NRWQC Criterion Continuous Concentration (CCC)
Total Residual Chlorine (µg/L)	19	11	13	7.5

¹ The NRWQC for chlorine in marine waters are expressed as chlorine produced oxidants (CPOs) as measured by total residual chlorine.

An important issue regarding application of the NRWQC to pool and spa discharges is that the minimum detection limits reported by analytical labs (typically 10 µg/L to 100 µg/L) exceeds the NRWQC. For this reason, nondetect values are generally used as the compliance evaluation level for total residual chlorine when applying the NRWQC.

State Limits

ERG's internet searches identified several states that issue general permits for the discharge of swimming pool wastewater from land-based facilities.³ Permit excerpts specific to surface water discharges of chlorine and bromine are provided in Attachment 1.⁴ Permit limits/rates vary by

² Email from Steve Collins, Cruise Lines International Association to Elizabeth Kim, US Environmental Protection Agency dated September 25, 2007.

³ ERG did not perform an exhaustive search for state general permits for discharges from swimming pools. Additional state permits may exist. ERG can perform an exhaustive search, if desired.

⁴ Permits include requirements for other types of discharges (e.g., POTW) and for other parameters (e.g., flow, copper). ERG can summarize these additional permit requirements, if desired.

state and range from best management practices (e.g., retaining pool water to allow chlorine to dissipate) to numerical standards with corresponding monitoring and reporting (e.g., daily maximum discharge limitation of 0.037 mg/L total residual chlorine). Note that the general term “swimming pool” typically includes swimming pools, spas/whirlpools/hot tubs, diving pools, wading pools, special purpose pools, etc. The general term “swimming pool wastewater” typically includes pool overflow, pool drainage, pool filter backwash, and pool cleaning wastewater (e.g., acid cleaning, pressure washing). See the State general permits for specific definitions for these terms for each permit.

Treatment for Chlorine and Bromine from Pools and Spas

Land-based pools use the following techniques to mitigate chlorine and bromine discharges:

- Retention;
- Chemical dehalogenation;
- Land application;
- Groundwater recharge;
- Discharge to storm sewer (with sufficient travel time to sewer);
- Discharge to sanitary sewer; and
- Dechlorination with activated carbon.

Of these, only retention and chemical dehalogenation are potentially applicable and practical for use onboard vessels.

Retention

Chlorine and bromine residuals in pools and spas gradually decrease over time due to aeration and reaction with air and sunlight. However, removal to non-detectable levels may require several hours to several days (2 to 7 days), which may not be acceptable for vessel operations.

Chemical Dehalogenation

Dehalogenation chemicals quickly and effectively neutralize chlorine and bromine residuals in pool and spa wastewater. Commonly used chemical agents include sodium thiosulfate, sodium sulfite, sodium bisulfite, and sodium metabisulfite. To be effective chemicals must be allowed to completely mix with wastewater and testing is necessary to ensure complete halogen removal prior to discharge.

The quantity of reagent used should be limited to the manufacturer recommended dosage. Chemical overdosing can remove dissolved oxygen, encourage bacterial growth, and can be toxic. Design and/or operating considerations need to be taken to prevent overdosing.

Attachment 1

Excerpts from State General Permits for the Discharge of Swimming Pool Wastewater

Connecticut (DEP-PERD-GP-005)⁵

(B) Surface Water Discharge

(i) The permittee shall not discharge swimming pool acid cleaning, pressure wash or swimming pool filtration backwash wastewaters to any surface water or wetland.

(ii) Swimming pool draining wastewaters may be discharged from a public or private residential pool to a surface water provided the following conditions are met:

2) Total residual chlorine or bromine shall be non-detectable as determined by a test kit commonly used in the pool industry (less than 0.1 mg/L).

⁵ http://www.ct.gov/dep/lib/dep/Permits_and_Licenses/Water_Discharge_General_Permits/swimpool_gp.pdf

Maryland (MDG76)⁶

A. Discharge Limits and Monitoring Requirements.

BACKWASH, DRAWDOWN, & SPA WATER

1. Surface water discharges of backwash wastewater or pool draw down water from public pools or spas shall be limited and monitored by the permittee as follows at each point of discharge:

Effluent Characteristics	Effluent Limitations		Monitoring Requirements	
	Quarterly Average	Daily Maximum	Measurement Frequency	Sample Type
Total Residual Chlorine (b), (c)	N/A	<0.019 mg/L	1/Month	Grab
Total Residual Bromine (b)	N/A	<0.1 mg/L	1/Month	Grab

(a) Only additives used in pool must be monitored.

(b) Because the minimum level (quantification level) for chlorine is 0.10 mg/L, all results below this minimum level shall be reported as <0.10 mg/L.

POOL CLEANING WASTEWATER

3. Surface water discharges of pool cleaning wastewater from public pools shall be limited and monitored by the permittee at the discharge point as follows. All turbidity samples shall be taken during the second half of the discharge.

Effluent Characteristics	Effluent Limitations		Monitoring Requirements	
	Quarterly Average	Daily Maximum	Measurement Frequency	Sample Type
Total Residual Chlorine (b), (c)	N/A	<0.019 mg/L	1/Discharge	Grab
Total Residual Bromine (b)	N/A	<0.1 mg/L	1/Discharge	Grab

(b) Only additives used in pool must be monitored.

(c) Because the minimum level (quantification level) for chlorine is 0.10 mg/L, all results below this minimum level shall be reported as <0.10 mg/L.

C. Other Disinfectants

1. When using Poly(hexamethylenebiguanide hydrochloride)-related disinfectants, hereinafter referred to as PHMB, the residual PHMB in discharges to surface waters is prohibited unless approved by the Department.

2. The use of disinfectants other than chlorine, bromine, PHMB compounds, copper, or silver, in swimming pool waters that will be discharged to State waters is prohibited unless approved by the Department.

⁶ http://textonly.mde.state.md.us/assets/document/permit/MDE-WMA-PER070_Permit_Language.pdf

Michigan (MIG769000)⁷

PART I

Section A. Effluent Limitations And Monitoring Requirements

1. Final Effluent Limitations

Parameter	Effluent Limitations		Monitoring Requirements	
	Monthly Maximum	Daily Maximum	Measurement Frequency	Sample Type
Total Residual Chlorine – No Bromine Use				
Continuous Discharge (≥160 min/day)	N/A	0.038 mg/L*	Prior to discharge	Grab
Intermittent Discharge (<160 min/day)	N/A	0.2 mg/L*	Prior to discharge	Grab
Bromine				
Intermittent Discharge (<120 min/day)	N/A	0.05 mg/L*	Prior to discharge	Grab

* DPD colorimeter test results are required to be non-detectable (with at least a minimum detection level of 0.4 mg/L).

2. Filter Backwash Water

The permittee is prohibited from discharging untreated filter backwash water directly into the surface waters of the state.

⁷ http://www.michigan.gov/documents/deq/wb-npdes-generalpermit-MIG769000_247744_7.pdf

Missouri (MO-G760000)⁸

A. Effluent Limitations and Monitoring Requirements

Effluent Parameter(s)	Effluent Limitations		Monitoring Requirements	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Filter Backwash				
Total Residual Chlorine	1.0 mg/L	1.0 mg/L	Once/month	Grab
Pool Drainage				
Total Residual Chlorine	1.0 mg/L	1.0 mg/L	Once/month	Grab

Requirements

1. The Total Residual Chlorine (TRC) concentration in the discharge is the principal parameter of concern. In order to allow chlorine to dissipate, chlorination must cease at least seven days prior to discharge. As an alternative, chemical dechlorination may be used to remove chlorine if desired.

⁸ <http://www.dnr.mo.gov/env/wpp/permits/issued/G760000.pdf>

New Jersey (NJ0128589)⁹

Chlorinated Discharges

The discharger shall take measures to reduce or eliminate any residual chlorine contained in the discharge. Swimming pool water may only be authorized under this permit if the level of chlorine has been effectively dissipated or reduced to prevent deleterious impacts to aquatic life or degradation of the surface water quality of the receiving waters. Contained chlorinated discharges (e.g., swimming pool water) shall be retained, after receiving the last dosing of chlorine, for a minimum of seven days, (or until such time that analysis indicates the level of chlorine to be nondetectable,) such that the chlorine level is reduced or dissipated through aeration or other means, prior to discharging these waters. A pool chlorination kit can be used to confirm that there is no detectable level of chlorine in the water prior to discharge.

Swimming Pool Filter Backwash

Only swimming pool filter backwash that meets all applicable requirements of this permit, including those set forth in this paragraph, are authorized by this permit. Whenever possible, discharges of swimming pool filter backwash shall be directed to the sanitary sewer. If disposal into a sanitary sewer system is not an option, the following measures must be taken prior to discharging the filter backwash into a storm sewer or to a surface water body. The swimming pool filter water shall be retained, until such time that the chlorine has dissipated, prior to discharging. The water used to backwash the filter should also be retained or discharged over a grassy area so those solids settle out and can be removed or are filtered out prior to discharging the water. Solids, residue, or sediment shall not be discharged to a waterway and shall be removed (i.e., discharged to a publicly owned treatment works (POTW), disposed of as solid waste, etc.) prior to discharging the filter backwash water to the receiving waterbody.

⁹ <http://www.state.nj.us/dep/dwq/pdf/swimgpl.pdf>

C. Requirements for Surface Water Discharges

Parameter	Effluent Limitations		Monitoring Requirements	
	Daily Minimum	Daily Maximum	Measurement Frequency	Sample Type
Total Residual Chlorine (TRC) (a)	N/A	0.037 mg/L	Once/month	Grab

(a) The permittee shall demonstrate compliance with the TRC monitoring requirement and effluent limitation using either of the following methods:

(i) Perform analytical testing for TRC as specified in Table 3 using EPA Method 330.1 or 330.2, or any other test method, approved by the Department prior to use, which provides a limit of detection (LOD) equal to or less than 0.1 mg/l. Analytical results of TRC levels less than 0.037 mg/l or less than the LOD are considered in compliance with the permit limit. TRC levels less than the LOD shall be reported as less than (<) the value of the LOD. For example, if it is not detected at a LOD of 0.1 mg/L, report the TRC level as <0.1 mg/L.

(ii) In place of analytical monitoring, the permittee can demonstrate compliance with the TRC permit limit by certifying, in writing, that it is using a chlorine minimization procedure that has been approved, in writing, by the Department.

(iii) The TRC limit does not apply to filter backwash discharges that backwash with water from a potable water supply, without adding additional chlorine.

(4) Chlorine Treatment Discharges shall be treated for removal of total residual chlorine (TRC) to meet TRC limits in Table 2.

(5) Swimming Pools Smaller than 67,000 Gallons For swimming pools smaller than 67,000 gallons that use chlorine minimization procedures prior to discharge, monitoring requirements in Table 3 do not apply. However, permit requirements and effluent limitations in Table 2 remain effective for these facilities. This section does not exempt whirlpools, spas, water slides, or any facilities other than swimming pools from monitoring requirements in Table 3.

¹⁰ http://www.dnr.state.wi.us/org/water/wm/ww/gpindex/46523_permit.pdf